## REMARKS

In the Office Action dated October 16, 2002, claims 1-10 were considered and pending claims 11-22 were withdrawn from further consideration as being drawn to a nonelected invention. The Office Action rejected claim 5 under 35 U.S.C. § 112, first paragraph, rejected claim 9 under 35 U.S.C. § 112, second paragraph, and rejected claims 1-10 under 35 U.S.C § 102.

In the present Amendment, claim 9 is amended to correct a typographical error. Claims 1-10 are presented for reconsideration. Applicants respectfully submit that no new matter is introduced by the present Amendment. In accordance with 37 C.F.R. § 1.121, a marked-up copy of the claims, and a clean copy of all pending claims, as amended herein, are attached.

*Claim Rejections Under 35 U.S.C. §112*

Applicants' claim 5 stands rejected under 35 U.S.C. §112, first paragraph, as allegedly containing subject matter which was not described in the specification in such a way as to enable one skilled in the art to make or use the invention. The Office Action states that polyurethane is not known to be bioabsorbable. Applicants respectfully traverse this rejection.

On page 8, line 18 of Applicants' originally-filed specification, degradable urethanes are included in a list of examples of biocompatible bioabsorbable polymers. Moreover, Exhibit A attached hereto includes some published examples of commonly known biodegradable polyurethane materials. As defined in Applicants' specification at page 5, lines 21-24, a bioabsorbable material includes any biodegradable material. Thus, Applicants respectfully submit that polyurethane is a known bioabsorable polymer and that one skilled in the art, after reading Applicants' specification would know how to make and use Applicants' invention. Applicants respectfully request that the rejection of claim 5 under 35 U.S.C. §112, first paragraph be reconsidered and withdrawn.

Claim 9 stands rejected under 35 U.S.C. §112, second paragraph as being indefinite. Specifically, claim 9 fails to provide sufficient antecedent basis for the recited limitation of "bioabsorbable material." Applicants thank the Examiner for pointing out this typographical error and, in response, Applicants have amended claim 9 to include proper antecedent basis. Accordingly, Applicants request that the § 112 rejection be withdrawn.

*Claim Rejections Under 35 U.S.C. § 102*

The Office Action rejects claims 1, 2, 4-8, and 10 under 35 U.S.C. §102(e) as being anticipated by U.S. Patent No. 6,264,676 issued to Gellman *et al.* (hereinafter "Gellman *et al.*"). The Office Action rejects claims 1, 2, 4-7, and 9 under 35 U.S.C. §102(b) as being anticipated by U.S. Patent No. 5,048,050 issued to Draenert (hereinafter "Draenert"). The Office Action rejects claim 1 and 3-5 under 35 U.S.C. §102(b) as being anticipated by U.S. Patent No. 5,997,541 issued to Schenk. Applicants respectfully traverse the § 102 rejections.

Anticipation under 35 U.S.C. § 102 requires that each and every element as set forth in Applicants' claim be found in a single prior art reference. Verdegaal Bros. v. Union Oil Co. of California, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987). (M.P.E.P. § 2131). In order to anticipate a claim, the identical invention must be shown in as complete detail as is contained in the patent claim. Richardson v. Suzuki Motor Co., 868 F.2d 1226, 1236, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989). (M.P.E.P. § 2131).

Applicants claim a medical device for attaching soft tissue to a bone. Applicants' medical device, as recited in independent claim 1, includes a bone anchor and a protective cover formed from a solid mass of biocompatible material; the bone anchor is substantially encapsulated in the mass.

Applicants respectfully submit that Gellman *et al.* fails to teach or even suggest the elements of claim 1. Specifically, Gellman *et al.* fails to teach or suggest a protective cover formed from a solid mass of biocompatible material. Instead, Gellman *et al.* teaches

covering a bone anchor with a balloon 279 or a gelatin structure or caplet 290. See Gellman *et al.*, column 19, lines 62-67, column 20, lines 29-32, column 21, lines 20-31, and FIGS. 26a and 26b showing a hollow cover, 279 and 290, respectively, protecting a bone anchor. Applicants respectfully submit that balloons and/or gelatin caplets are hollow masses, which can be filled or inflated and are therefore not solid masses. Thus, Applicants respectfully submit that Gellman *et al.* fails to disclose all of the elements of their claimed invention and request that the rejection of independent claim 1 under 35 U.S.C. § 102(e) be reconsidered and withdrawn.

Applicants respectfully submit that Draenert also fails to teach or suggest Applicants' claimed protective cover formed from a solid mass of biocompatible material. Rather, Draenert teaches an implant 10 having a form of a structured hollow cylinder with axis 12. See Draenert, column 7, lines 33-34 and FIG. 1. Since Draenert teaches only hollow implants to cover a bone screw, Applicants respectfully submit that Draenert fails to teach or suggest a medical device including a protective cover formed from a solid mass of biocompatible material. Applicants request that the rejection of independent claim 1 under 35 U.S.C. § 102(b) in view of Draenert be reconsidered and withdrawn.

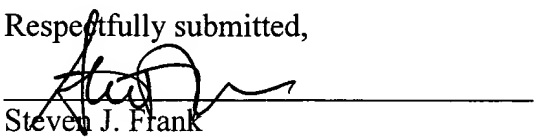
Further, Applicants submit that Schenk fails to teach or suggest all of the elements of Applicants' claim 1. Specifically, Schenk, like Gellman *et al.* and Draenert, fails to teach or suggest a protective cover formed from a solid mass of biocompatible material. Instead, Schneck teaches a hollow cylindrical body 2 that covers a bone screw. See Schenk, column 3, lines 49-53 and FIGS. 1 and 2. As discussed above, Applicants submit that a hollow cylindrical body or implant is not a solid mass. Thus, Schenk, like Gellman *et al.* and Draenert, fails to teach a protective cover formed from a solid mass of biocompatible material.

Applicants also request that the 35 U.S.C. § 102 rejections of claims 2-10 be withdrawn. Claims 2-10 depend directly or indirectly from independent claim 1 and thus are patentable at least for all the reasons that claim 1 is patentable.

## CONCLUSION

Applicant respectfully requests entry of this amendment and response, withdrawal of all bases of rejection, and allowance of claims 1-10 in due course. The Examiner is invited to telephone Applicant's under signed representative at (617) 310-8108 to discuss any outstanding issues.

Respectfully submitted,



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## MARKED-UP COPY OF AMENDMENTS TO THE CLAIMS

Please amend claim 9 as follows:

9. (Amended) The protective cover of claim 8, wherein said antibiotic is disposed within [said]a bioabsorbable material to form said protective cover.

## CLEAN COPY OF ALL PENDING CLAIMS

1. A medical device for attaching soft tissue to a bone comprising a bone anchor and a protective cover formed from a solid mass of biocompatible material, wherein said bone anchor is substantially encapsulated in said mass.

2. The protective cover of claim 1, wherein said mass is substantially deformable.

3. The protective cover of claim 1, wherein said mass is substantially brittle.

4. The protective cover of claim 1, wherein said mass comprises a bioabsorbable material.

5. The protective cover of claim 4, wherein said bioabsorbable material is selected from the group consisting of cross-linked alginated gel, cross-linked collagen, cross-linked hyaluronic acid hydrogel, polylactic-co-glycolic acid, polylactic acid, polyglycolic acid, polyurethane.

6. The protective cover of claims 1, further comprising an antimicrobial material.

7. The protective cover of claim 6, wherein said antimicrobial material comprises an antibiotic.

8. The protective cover of claim 7, wherein said antibiotic is selected from the group consisting of nafcillin, aminoglycoside, ciprofloxin, piperacillin/tazobactum, ampicillin/sulbactum, vancomycin, cephalosporin, TMP/SMX, ampicillin, gentamicin, tobramycin, and ciprofloxacin.

9. The protective cover of claim 8, wherein said antibiotic is disposed within a bioabsorbable material to form said protective cover.

10. The protective cover of claim 8, wherein said antibiotic is applied to at least one surface of said protective cover.

11. A method of inserting a bone anchor into a bone, comprising:

(a) providing a bone anchor;

(b) providing a protective cover adapted to encapsulate said bone anchor;

(c) encapsulating said bone anchor in said protective cover;

(d) locating a bone anchor implantation site on a bone; and

(e) causing said bone anchor to penetrate said protective cover and implant in said bone.

12. The method of claim 11, wherein said bone anchor is encapsulated in said protective cover prior to engagement of said bone anchor to an implantation device.

13. The method of claim 11, wherein said bone anchor is encapsulated in said protective cover after engagement of said bone anchor to an implantation device.

14. The method of claim 11, wherein said protective cover for encapsulating a bone anchor comprises a generally ellipsoidal mass.

15. The method of claim 14, wherein said mass is substantially deformable.

16. The method of claim 14, wherein said mass is substantially brittle.

17. The method of claim 14, wherein said mass comprises a bioabsorbable material.

18. The method of claim 17, wherein said bioabsorbable material is selected from the group consisting of cross-linked alginated gel, cross-linked collagen, cross-linked hyaluronic acid hydrogel, polylactic-co-glycolic acid, polylactic acid, polyglycolic acid, polyurethane.

19. The method of claims 18, wherein said protective cover further comprises an antibiotic.

20. The method of claim 19, wherein said antibiotic is selected from the group consisting of nafcillin, aminoglycoside, ciprofloxin, piperacillin/tazobactum, ampicillin/sulbactum, vancomycin, cephalosporin, TMP/SMX, ampicillin, gentamicin, tobramycin, and ciprofloxacin.

21. The method of claim 20, wherein said antibiotic is disposed within said bioabsorbable material to form said cover.

22. The method of claim 20, wherein said antibiotic is applied to at least one surface of said protective cover.

# Research Projects

**In the Woodhouse lab, our focus is on the development of biomaterials for use in tissue engineering. The materials we work with are intended primarily for soft tissue applications such as the cardiovascular system, the skin, and the bladder. Our research currently falls under three distinct types of biomaterials:**

- **Acellular Matrix Biomaterials**
- **Biodegradable Polyurethanes**
- **Recombinant Elastin Peptide Materials**

**There exists a great deal of potential to combine two or more of the above materials into composite biomaterials as well.**

## Acellular Matrix Biomaterials:

Acellular matrix (ACM) materials are created by harvesting natural tissue and then subjecting it to a series of detergent and chemical rinses. This process removes most of the cellular material and soluble proteins that can cause an antigenic response from the tissue, while preserving the collagen and elastin architecture of the original tissue. The acellularization protocols being used in the Woodhouse lab have been adapted from those original developed by Courtman et al (Hospital for Sick Children, Toronto) for cardiovascular applications. We have acellularized dermal (skin) tissue, bladders and placentas. Tissue engineering approaches involving the ACM include both pre-seeding of the matrices with cells and the incorporation of active molecules that might encourage cellular infiltration into the material post-implantation. The acellularization technique can be applied to numerous other tissues as well. As a result, the range of uses for the ACM in tissue engineering are vast.

These matrices not only hold promise for use as biomaterials, but also have been found to provide an alternative to collagen gels for use as an in *vitro* model for assessing cell-cell and cell-protein interactions. Through the re-incorporation of a single extracellular molecule into the ACM, relationships between a cell line and the molecule in question can be investigated in a model more closely resembling the natural body.

**References:**

1. Brown AL, Farhat W, Merguerian PA, Wilson GJ, Khoury AE and Woodhouse KA. 22 Week assessment of bladder acellular matrix as a bladder augmentation material in a porcine model. *Biomat.*, in press.
2. Wilson GJ, Yeger H, Klement P, Lee JM and Courtman DW. Acellular matrix allograft small caliber vascular prostheses. *Trans. Am. Soc. Artif. Intern. Organs*, **36**: M340-343, 1990.

3. Courtman DW, Pereira CA, Kashef V, McComb D, Lee JM and Wilson GJ. Development of a pericardial acellular matrix biomaterial: Biochemical and mechanical effects of cell extraction. *J. Biomed. Mater. Sci.* **28**: 655-666, 1994.

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# Biodegradable Polyurethanes:

We have developed a family of biodegradable elastomeric segmented polyurethanes. These materials were created in order to fill the need for malleable, elastic degradable polymers for use in soft tissue engineering applications. The polyurethanes are comprised of a lysine-based diisocyanate, an L-phenylalanine-based diester chain extender, and either polyethylene oxide (PEO) or polycaprolactone (PCL) diols as the soft segment. The use of an amino-acid-based isocyanate is intended to prevent the toxicity and carcinogenicity frequently associated with more commonly used diisocyanates. The incorporation of L-phenylalanine into the chain extender serves to incorporate enzyme recognition sites into the polyurethane backbone. Chymotrypsin-like enzymes in particular will help to speed up the degradation of these polyurethanes *in vivo*.

Current work on the polyurethanes includes:

- creating blends of the PCL and PEO-based polyurethanes
- fabrication of three-dimensional scaffolds
- development of cardiac muscle patches

**References:**

1. Skarja GA and Woodhouse KA. Synthesis and characterization of degradable polyurethane elastomers containing an amino acid-based chain extender. *J. Biomat. Sci., Polym. Ed.* **9**(3):271-295, 1998.
2. Skarja GA and Woodhouse KA. Structure-property relationships of degradable polyurethane elastomers containing an amino acid-based chain extender. *J. Appl. Polym. Sci.* **75**: 1522-1534, 2000.
3. Skarja GA and Woodhouse KA. *In vitro* degradation and erosion of degradable, segmented polyurethanes containing an amino acid-based chain extender. *J. Biomat. Sci., Polym. Ed.* **12**(8): 851-874, 2001.
4. McDevitt TC, Woodhouse KA, Murray CE, and Stayton PS. Spatially organized layers of cardiomyocytes on biodegradable polyurethane films for myocardial repair. Submitted.
5. Fromstein JD and Woodhouse KA. Novel elastomeric polyurethane blends for soft tissue applications. *J. Biomat. Sci., Polym. Ed.* Submitted, 2001.
6. Elliott SL, Fromstein JD, Santerre JP and Woodhouse KA. Identification of biodegradation products formed by L-phenylalanine based segmented polyurethaneureas. *J. Biomat. Sci., Polym. Ed.* Submitted, 2001.

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# Recombinant Elastin Peptide Materials:

A family of human recombinant elastin peptides, developed in the laboratory of Dr. Keeley at the

Hospital for Sick Children, have been shown to have some of the same self-assembly and cross-linking properties as elastin itself. In addition, the peptides appear to be anti-thrombogenic. As a result, these molecules are of interest to us for use in the development of biomaterials. One simple application for blood-contacting biomaterials involves the use of the peptides to coat the material prior to implantation. In addition to coatings, the self-assembly properties of the peptides are being exploited to form cross-linked materials. In order to impart greater strength and control to the biomaterials, another project involves the conjugation of the peptides to polyethylene glycol (PEG) in an attempt to make a composite material. The resulting materials will hopefully possess some of the self-assembly, cross-linking and biocompatibility properties of the peptides, while maintaining the versatility of being a primarily PEG-containing material.

**References:**

1. Bellingham CM, Woodhouse KA, Robson P, Rothstein SJ and Keeley FW. Self-aggregation characteristics of recombinantly expressed human elastin polypeptides. *Biochim. et Biophys. Acta-Prot. Struct. Mol. Enz.* **1550**(1): 6-19, 2001.

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